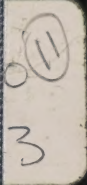


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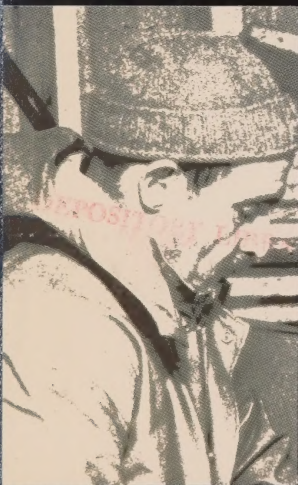
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# Recommended International Code of Practice for Handling Fresh Fish at Sea



## **Note to Users**

The portion of this Code of Practice dealing with "Handling of Fresh Fish at Sea" has been reproduced by the Department of Fisheries and Oceans for the information and use of fishermen. The Code of Practice is general in nature and may not deal affectively with specific fisheries. Detailed codes are being developed for these fisheries and will be distributed at a later date.

November 1980

Published by:  
Communications Branch  
Fisheries and Oceans  
Ottawa, Ontario K1A 0E6

Pub. No. Q.E.P. 80/002E

© Minister of Supply and Services Canada 1980  
Cat. No. Fs 21-1/1-1980 E  
ISBN 0-662-11029-3



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Publications  
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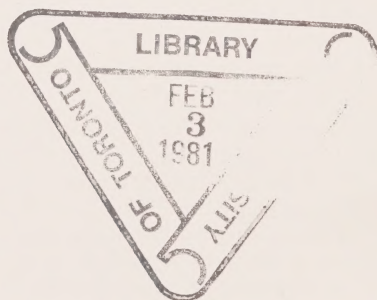
## INTRODUCTION

The FAO/WHO (Food and Agriculture Organization/World Health Organization) Codex Alimentarius Commission was established to implement the Joint FAO/WHO Food Standards Program. Membership of the Commission comprises those Member Nations and Associate Members of FAO and/or WHO which have notified the Organizations of their wish to be considered as Members. By 30 April 1976, 114 countries had become Members of the Commission. Other countries which participate in the work of the Commission or of its subsidiary bodies in an observer capacity are expected to become Members in the near future.

The purpose of the Joint FAO/WHO Food Standards Program is to protect the health of consumers and to ensure fair practices in the food trade; to promote co-ordination of all food standards work undertaken by international governmental and non-governmental organizations; to determine priorities and initiate and guide the preparation of draft standards and codes of practice through and with the aid of appropriate organizations; to finalize standards and codes of practice and after acceptance of the standards by governments, publish them in a Codex Alimentarius either as regional or as world-wide standards.

At its eleventh session, held in March/April 1976, the Commission adopted as a recommended code of practice to be sent to all Member Nations and Associate Members of FAO and/or WHO a Code of Practice for Fresh Fish.

This code of practice is to be regarded as being advisory in nature and it is for individual governments to decide what use they wish to make of the code. The Commission has expressed the view that codes of practice dealing with specific categories of foods might provide useful checklists of requirements for national enforcement authorities.



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## PREFACE

The Code of Practice for handling Fresh Fish at sea has been developed under the auspices of the Codex Alimentarius Commission by the Codex Committee on Fish and Fishery Products by combining the code of technological practice, elaborated in 1969 by the FAO Department of Fisheries, Fishery Products and Marketing Branch assisted by *Ad Hoc* Consultations and published in the same year as FAO Fisheries Report No. 74, with the code of hygienic practice for fresh fish as proposed by the Codex Committee on Food Hygiene.

The aim of this code is to assist those concerned with the handling and processing of fresh fish for the fresh fish market to produce a product of a high standard. The quality of the end product will depend mainly on the technological and hygienic practices applied and equipment employed from the time of catching to marketing.

Fish catching and processing for human consumption can only be profitable when the consumer is satisfied with the quality and price of the product. This situation requires the observance of high and uniform standards of handling and processing. The advice given here will help to maintain and where necessary raise the quality of fresh fish, so that it should be acceptable in both national and international trade.

One aspect which requires particular consideration is the fact that different people in different parts of the world do not have identical consumer requirements. Handling and processing practices, as advised in this code, will ensure that the quality standard of even the most sophisticated consumer can be met. Where prevailing quality requirements are less demanding, less strict handling practices may be adopted; however, advice which refers to hygienic conditions and wholesomeness of product allows for little or no flexibility, as the basic principles of hygiene should generally be applicable throughout the world.

The code deals with fresh fish for human consumption, which are chilled but not frozen. The information given here is based on the best technological knowledge currently available, and on basic principles as established in the light of modern research results. Both the knowledge and principles are applicable to all fisheries throughout the world and the code is therefore a guide to good practice in all areas, giving broad recommendations and explaining in simple terms the underlying reason for these. Where on occasion present knowledge does not allow firm recommendations to be made this is clearly stated.

It must be acknowledged that most of the practical information on fish handling and processing, both at sea and on shore, has been gained from particular areas, mainly the North Atlantic and North Pacific fisheries. Much less is known from fisheries in other areas, for example in the tropics. Furthermore it should be appreciated that the variety of existing fishing vessels, the many types of gear used and the number of species involved in world fisheries, do not allow for a single code of handling practice to be drawn up, covering all types of fisheries.

This code, therefore, is not intended to replace the advice or guidance of trained and experienced technologists regarding the complex technical problems which might be unique to a specific geographical area or specific fishery.

The practical application of this "international" code, with regard to "national" fisheries, may therefore require some modifications and amendments, taking into account local conditions and specific local consumer requirements. In other words, "national" codes of practice could be elaborated for the guidance of individual fisheries, based on this code.



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The code is further intended for information purposes and as a guideline for the elaboration of national quality standards, quality control and fish inspection regulations in countries where these, as yet, have not been developed. In addition, it could be used for training of fishermen and employees of the fish processing industry.

In this code no firm conclusions have been reached regarding the need for certain practices which are common in some countries, for example the removal of gills. Matters of this type have therefore been omitted or mentioned without any firm recommendations being given. Similarly, super-chilling, that is the reduction of the temperature of the fish below  $-1^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ) under controlled conditions, has also been omitted. It is thought that although this method of storage and preservation may be of considerable interest in some fisheries, there is not yet sufficient experience in the practice to permit a proper assessment of its value, or to give advice on how it should be carried out.

Food additives have been excluded from the code, since consideration of their use belongs elsewhere. No reference is therefore made to the use of antibiotics or chemical additives in ice or brine.

Operational codes such as the present will require to be revised periodically to incorporate new developments and techniques introduced commercially for the handling and processing of fresh fish.

The special requirements for retailing fresh fish are not included here; these will be dealt with separately. The recommendations apply in general also to fresh water fisheries but these are not dealt with specifically.

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1. **SECTION I — SCOPE**

This code of practice applies to fresh fish, chilled but not frozen, intended for human consumption. It contains the technological guidelines and the most essential requirements of hygiene for the handling and processing of fresh fish at sea.

The special requirements for retailing of fresh fish and their products or the use of food additives are not included.

Although the code does not deal specifically with the fresh water fisheries, most of the recommendations made would apply.



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## 2. SECTION II — DEFINITIONS

For the purpose of this code:

- 2.1 boxed stowage is the storage of fish on board the vessel in boxes;
- 2.2 bulk stowage is the mass storage of fish in pounds on board the vessel;
- 2.3 chilling is the process of cooling fish to a temperature approaching that of melting ice;
- 2.4 chilled sea water is clean sea water whose temperature is 0°C (32°F) or slightly below;
- 2.5 clean sea water is sea water which meets the same microbiological standards as potable water and is free from objectionable substances;
- 2.6 cleaning means the removal of objectionable matter from surfaces;
- 2.7 contamination means direct or indirect transmission of objectionable matter to the fish;
- 2.8 disinfection means the application of hygienically satisfactory chemical or physical agents and processes to clean surfaces with the intention of eliminating micro-organisms;
- 2.9 fillet is a slice of fish of irregular size and shape removed from the carcass by cuts made parallel to the backbone;
- 2.10 fish means any of the cold-blooded aquatic vertebrate animals commonly known as such. This includes Pisces, Elasmobranchs and Cyclostomes. Aquatic mammals, invertebrate animals and amphibians are not included. It should be noted, however, that many of the recommendations given here also apply to certain invertebrates, particularly Cephalopods;
- 2.11 fresh fish are freshly caught fish which have received no preserving treatment or which have been preserved only by chilling;
- 2.12 gutted fish are fish from which the guts have been removed;
- 2.13 keeping time refers to the length of time that fish will remain wholesome and acceptable as human food;
- 2.14 market is an area or building used for the display and first sale of the catch;
- 2.15 packaging materials are all those materials such as foils, films, waxpaper, cartons and boxes, used for covering and protecting the fresh fish or fresh fish products, and which are approved by the official agency having jurisdiction;
- 2.16 plant or establishment means the building or buildings, or part thereof, used for, or in connection with, the manufacture or holding of food for human consumption;
- 2.17 potable water is fresh water fit for human consumption. Standards of potability should not be lower than those contained in the latest edition of the "International Standards for Drinking Water", World Health Organization;
- 2.18 pounds or pens are areas in the fish hold and on deck, divided off by stanchions and portable or fixed board structures for the storage of fish;
- 2.19 refrigerated brine is a solution of food grade salt (sodium chloride) in potable water of about the same salinity as sea water which is cooled in the same manner as refrigerated sea water;

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- 2.20 refrigerated sea water is a clean sea water cooled by the addition of ice prepared from potable water or clean sea water and/or a suitable refrigeration system. Its salt content is normally about three per cent;
- 2.21 rigor mortis means the stiffening of the muscles of an animal which results from a series of complex changes that take place in the tissues shortly after death. Immediately after death, the muscles are soft and limp and can be easily flexed. At this time, the flesh is said to be in pre-rigor condition. Soon the muscles begin to stiffen and harden and no longer contract by stimulation. The animal then is in rigor. After some hours or days, the muscles gradually begin to soften and become limp again. This is called the post-rigor condition;
- 2.22 shelf stowage is the storage of fish on board the vessel in single layers, on shelves;
- 2.23 steak is a section of fish, removed by cutting approximately at right angle to the backbone;
- 2.24 suitable corrosion-resistant material means impervious material, which is free from pits, crevices and scale, is non-toxic and unaffected by sea water, ice, fish slime or any other corrosive substance with which it is likely to come in contact. Its surface must be smooth and it must be capable of withstanding exposure to repeated cleaning, including the use of detergents;
- 2.25 whole fish are fish as captured, ungutted.

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### 3. SECTION III — RAW MATERIAL REQUIREMENTS

#### 3.1 General Principles of Fish Spoilage

Soon after fish are dead, they begin to spoil, hence fresh caught fish pass through various stages of decay until they become putrid and unfit for human consumption.

Spoilage occurs for two main reasons: firstly, the controlled biochemical processes (digestive enzymes) which occur in all living tissues to assist the digestion of food, continue after death in an uncontrolled manner. These digestive enzymes then begin to attack the surrounding flesh, causing it to become soft.

Secondly, micro-organisms are present on the gills, in the surface slime and in the intestines of live, healthy fish, but not in the flesh, which is sterile. Soon after death, micro-organisms on the skin, surface slime and intestines multiply rapidly and can soon be detected in the flesh near the skin and belly walls. The spread into the flesh can be much more rapid if the fish have been damaged in any way. The micro-organisms continue to multiply inside the flesh, and at the same time begin to break down the tissues into a series of compounds with strong odours and tastes, and thus the fish become spoilt. In some species fat oxidation will also quickly occur and alter the flavour. The rate of chemical change and of microbial activity depends on temperature. In general, the closer the temperature is to that of melting ice, 0°C (32°F), the slower the rate of chemical and microbiological spoilage. For this reason, ice in one form or another is used throughout the world to prolong the storage life of fish.

Since micro-organisms from both intestines and surfaces with which the fish come in contact, play a major part in fish spoilage, high standards of cleanliness at all stages of handling, processing, storage and distribution are essential. This means that strict attention must be given to the efficient cleaning of the fish, the regular cleaning of all surfaces with which the fish come in contact, the provision of an uncontaminated water supply and the hygiene of workers. These factors are all important in order to provide the consumer with good quality wholesome food.

Chemical composition of fish flesh varies from species to species and even within species according to season, maturity, fishing ground, feed, etc. The rate of spoilage can therefore vary, and the spoilage pattern can be influenced by these factors.

##### 3.1.1 **Fresh fish are an extremely perishable food, and should be handled at all times with great care and in such a way as to inhibit multiplication of micro-organisms**

Fish quality deteriorates rapidly, and the potential keeping time is shortened if they are not handled and stored properly. Much of the fish landed for human consumption is unfortunately subjected to fairly rough handling treatment which should be avoided. Fish should not be exposed to direct sunlight or to the drying effect of winds, or any other harmful effects of the elements, but should be carefully cleaned and cooled down to the temperature of melting ice, 0°C (32°F), as quickly as possible. Any careless treatment or delay in reducing the temperature of the fish will have a marked effect on their potential keeping time.



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### 3.1.2 **Fish intended for marketing as fresh fish should be of the highest possible quality**

Although there are many aspects that might be taken into account when defining what is meant by the “highest possible quality” fish, there are two major ones that should concern the fisherman as a primary producer:

1. quality of fish when caught, and
2. quality of fish on delivery to the buyer or the processor.

The first one is determined by the physical condition of the fish, and includes appearance, size, percentage of fat, amount of feed, damage to skin, presence of disease and of harmful substances. The second one will result from the methods and techniques employed in fishing, practices in handling and conditions of storage while on board the fishing vessel.

The fishermen should discard any fish that is diseased or is known to contain harmful substances or has undergone deterioration or any process of decomposition or which has been contaminated with foreign matter to an extent which has made it unfit for human consumption.

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#### 4. SECTION IV A — FISHING VESSEL FACILITIES AND OPERATING REQUIREMENTS

##### 4.1 General Considerations

##### 4.1.1 **The fishing vessel should be designed for rapid and efficient handling of fish, ease of cleaning and disinfection, and should be of such material and construction as not to cause any damage or contamination of the catch**

In designing a fishing vessel many other factors, apart from the vessel's performance as a harvesting unit, should be considered. The fisherman's earnings are determined not only by the quantity of the fish caught but, to a great extent, by the quality of the catch delivered to the processing plant. Fishing vessels should be designed and constructed so as not to cause contamination of fish with bilge, water, sewage, smoke, fuel, oil, grease or other objectionable substances. Fish should be protected against physical damage, exposure to high temperatures and drying effects of sun and wind.

All surface with which the fish might come in contact should be of suitable corrosion-resistant material which is smooth and easily cleanable.

If a vessel is engaged in the processing of fish, then its design, layout, construction and equipment should meet the requirements of shore establishments and the processing should be carried out under similar hygienic conditions.

##### 4.2 Fishing Vessel Construction and Sanitary Design

##### 4.2.1 **Deck pound or pen stanchions and dividing boards should be constructed of suitable corrosion-resistant material. They should be adequate in number and height to prevent movement of the fish, due to the vessel's motion**

In practice, wood is still used in many fisheries for deck pound boards and steel for stanchions and other fixtures. Where this is the case, the wood should be treated to prevent the entry of moisture and should be coated with a durable paint or other non-toxic surface coating that is smooth and readily cleanable. Steelwork should be coated with anti-corrosion and non-toxic paint. Whenever possible, suitable corrosion-resistant materials should be used.

##### 4.2.2 **Deck pound or pen dividing boards should be fitted to allow for easy removal, and should have hand grips. Boards should have gates fitted, as required, and drain notches cut in the lower edges**

Gates are required to be fitted to the boards so that offal can easily be disposed of. Drain notches allow water, slime and blood to flow away from fish lying in the pounds.

##### 4.2.3 **Fish holds or tanks should be adequately insulated with a suitable material. Any pipes, chains or conduits passing through the hold should, if possible, be sunk flush or neatly boxed in and insulated**

Adequate insulation will reduce the amount of heat entering the fish hold and consequently the rate of ice meltage. If the quality and structure of the insulation is poor, considerable ice meltage will take place near bulkheads and shipside. This may cause excessive leaching of the fish and if the amount of ice is not sufficient, this will allow fish temperatures to rise, and any fish which come in contact with the ship's structure may develop a particularly offensive smell.

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- 4.2.4 Fish hold or tank linings should be completely water-tight. The insulation layer should be protected by a lining made of corrosion-resistant metal sheets or any other equally suitable material having water-tight joints**
- It is most important to prevent water from carrying fish slime, blood, scales and offal to parts of the vessel where effective cleaning is virtually impossible. The melt water seeping through the fish hold lining will also reduce the efficiency of the insulation and this will, in turn, lead to an increase in the temperature of the fish. The insulation should be covered with corrosion-resistant metal sheets or any other equally suitable material having water-tight joints to ensure protection from such contamination. An effective drainage system should be able to remove the melt water into a sump as fast as it accumulates.
- 4.2.5 Wooden fish holds or wooden holding tanks should be lined with a suitable material**
- The lining of wooden fish holds should be similar to that described above. They should be sealed and coated with a suitable impervious and non-toxic material which is easy to keep clean and not difficult to repair.
- 4.2.6 Portable boards of suitable corrosion-resistant material or impregnated and painted wood should be used for making shelves and vertical divisions in the fishroom**
- The use of portable boards, which are a good fit in the stanchions, allows the shelf and dividing structure to be dismantled and removed for cleaning. Wooden boards should be treated to prevent the entry of moisture and should be coated with a durable non-toxic paint or other equally suitable surface coating that is smooth, readily cleanable and repairable. Whenever possible, the shelving and the partitioning boards should be interchangeable in size.
- 4.2.7 Shelving boards should be designed to allow adequate drainage**
- A continuous trickle of melt water will help to carry away slime, blood and micro-organisms which should not be allowed to collect on the shelves. Corrugated boards of corrosion-resistant material are most suitable for this purpose.
- 4.2.8 The shelves should be installed so that the maximum depth of fish, when bulk stowing, does not exceed one metre (three feet)**
- This is considered to be a maximum depth, and may be excessive for certain types of fragile fish. Experience has shown that the pressure caused by piling iced fish in greater depth results in weight losses and damages to the fish at the bottom of the pile. Where iced fish is stowed in deep pounds, shelves should be fitted at frequent intervals, to transfer the weight of the load to the hold structure and hull, without undue pressure on fish stowed below.
- 4.2.9 There should always be ample drainage space between the lowest shelves and the floor of the fish hold. This space should be open to a central drain, discharging directly into one or more sumps, or wells, located so that the hold can be efficiently drained at all times. Bilge pump connections to these sumps should be fitted with coarse screen filters**
- Proper drainage facilities are required to prevent a build-up of large quan-



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ties of melt water, blood and slime. If drainage is inadequate, the bottom layers of the fish in the hold will be contaminated by this dirty liquid, especially during any periods of severe motion of the vessel.

**4.2.10 Where boxing at sea is carried out the stanchions and dividing structure should be designed to accommodate boxes of fish without leaving large air gaps**

If the structure is not designed to suit the box dimensions, large gaps will be left where air can circulate, causing excessive ice meltage. Unless these spaces are filled with extra ice the fish temperature will rise.

**4.2.11 If cooling grids are fitted in the fish hold they should be properly installed and operated**

Cooling grids, fitted in the fish hold, can be used to prevent excessive ice meltage during the voyage to the fishing grounds. They are valuable in cooling the fish hold and absorbing heat leak, especially in tropical waters. To be effective they should be fitted under the deckhead and on the ship side, and once fish has been stowed in the hold, control must be such that the hold temperature does not fall below 0°C (32°F). If it does, the top layer of ice may freeze into a solid crust, resulting in the top layer of fish being frozen slowly, on a long voyage, thus affecting their quality.

When the ice stops melting because of low temperature, its effectiveness as a cooling agent diminishes considerably. The frozen crust of ice and fish will act as an insulating blanket preventing the fish below from being adequately chilled. Only when the ice is melting and the resulting ice-cold melt water percolates downwards through the layers of fish, the removal of heat (chilling) takes place. The cooling grids alone, fitted into the well insulated fish hold, will not cool the fish or maintain them in a chilled condition.

**4.2.12 Except for tank stowage in refrigerated sea water or refrigerated brine, the stowage of fish for human consumption in holds that are not divided into pounds is not recommended. The holds of small vessels carrying such fish as herring should be fitted with at least one longitudinal and one athwartship bulkhead, which can be removed if the vessel converts to other types of fishing. Such bulkheads should be constructed of smooth, non-absorbent, easily cleanable material**

The fitting of removable type bulkheads increases the versatility of fishing vessels and prevents movement of the stowed fish. They also permit rapid conversion to other types of fish stowage.

**4.2.13 Holds that are not divided into pounds or pens should have an adequate number of drain lines located at intervals along the hold, discharging to a central drain or bilge. Vertical drain slots should be located along both the forward and aft bulkheads, running from deckhead to bilge**

As has already been stated, holds which are not divided into pounds are not to be recommended. Those which do exist in very small vessels also require adequate drainage facilities.

In a hold containing tanks, floor troughs should be installed, draining from all areas of the hold to a bilge sump. Fish hold bilge sumps should have separate piping and valves so that fish juices and slime do not flow into the other bilge lines.

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- 4.2.14 There should be no sharp corners or projections in the hold or tank as these will make cleaning difficult and may damage the fish**
- Contamination with fish slime, blood, scales and guts will build up rapidly on surfaces, in corners or around projections which are not smooth and impervious.
- Any ledges or projection resulting from the encasement of pipes, wires, chains and conduits, that are passing through the fish hold, should be so constructed as to allow free drainage, ease of cleaning and not to cause any physical damage to the fish.
- 4.2.15 Refrigerated clean sea water or refrigerated brine may also be considered for some fisheries**
- The storage temperature achieved by refrigerated clean sea water or refrigerated brine makes it possible to chill large quantities of fish quickly, in tanks, and maintain the fish in a chilled condition. Fish are chilled more rapidly by this immersion process than when iced, and if stowed at the correct density are in close contact with the cooling medium at all times.
- This type of stowage has been found successful where very large quantities of small fish are caught in each haul and where it would be difficult to stow the catch quickly in ice. It has so far only proved successful for very short voyages. A storage time of more than a few days can affect the appearance of certain species, and the scouring effect of fish rubbing together in a tank of water can also remove the scales from some species.
- There is as yet insufficient evidence to recommend refrigerated sea water or refrigerated brine for every type of fishery but experience has shown that for some species, notably Pacific halibut, Pacific salmon and tuna, it is a good method of preservation at sea.
- 4.2.16 Refrigerated sea water or refrigerated brine systems should be properly designed to give adequate cooling capacity**
- If the use of a refrigerated brine system is considered, the system should be the subject of much research before an investment of money is made. The system should be designed by refrigeration experts having a knowledge of the fishery, including catching and stowage rates, fish, water and ambient temperatures. The cooling capacity must be related to catching rates in the fishery involved. The system must be capable of rapidly chilling large quantities of fish
- 4.2.17 In all ships using refrigerated sea water or refrigerated brine systems for preservation of the catch, tanks, heat exchangers, pumps and associated piping should be made of, or coated with suitable corrosion-resistant material. They should be designed so that they can easily be cleaned and disinfected**
- With hard, non-porous surfaces such as stainless steel, aluminium-alloys or plastics, spoilage micro-organisms together with all the debris deposited during storage of the fish can be easily removed, thus reducing the risk of contaminating later catches. It is important to avoid corners and edges in which filth can lodge.
- The whole system should be so designed as to allow an easy introduction and effective circulation of the cleaning and disinfecting solutions. There should be no place where a proper cleaning cannot be carried out.

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It is important to remember that with ice storage only part of a load may spoil but with refrigerated sea water or brine, any malfunctioning of the system or neglect on the part of operators, can result in the whole catch being rejected for spoilage.

**4.2.18 Where clean sea water or brine and ice mixtures are used for cooling and storing the catch, there should be adequate circulation of the liquid**

Effective means of circulating the cold liquid around the mass of fish should be provided. If pumping facilities are inadequate some of the load may not be cooled properly, resulting in fish with highly unpleasant odours and flavours.

The fish hold-tanks should be equipped with suction screen arrangements which are strong enough to withstand the pressure exerted by the brine — fish mixture as well as negative pressure (suction) created by the circulating pump. Such screens should be so designed and located as to allow a constant and unobstructed flow of cold brine or sea water.

**4.2.19 Refrigerated sea water or refrigerated brine tanks should be insulated to minimize heat leakage from their surroundings**

The temperature of the refrigerated sea water will be more uniform throughout the tank and more easily controlled if the heat leak from other sources is reduced by effective insulation.

**4.2.20 Refrigeration plant and sea water or brine circulating equipment should be adequate to maintain the temperature of the fish at -1°C (30°F)**

In fresh fish maximum delay of spoilage is obtained at this temperature. If the temperature is reduced below -1°C (30°F) the fish may be damaged because of partial freezing. In practice it is extremely difficult to control the temperature so precisely, but a range of -1°C to +2°C (30° to 34°F) is achievable.

There should also be a sufficient compressor capacity to prevent a significant rise in temperature of the prechilled sea water or brine solution when the holding tanks are being loaded with the freshly caught fish.

Rapid cooling of fish is the primary task of the system. Once the initial cooling of fish is accomplished, the subsequent maintenance of constantly low temperature requires only a fraction of the compressor's load. Thermal inertia of a large body of chilled fish and brine should prevent sudden and significant fluctuations in temperature.

**4.3 Sanitary Facilities**

**4.3.1 Areas of the deck where fish are unloaded and handled, or the fish hold where fish are stowed should be used exclusively for these purposes**

All such areas should be well defined, be readily capable of being maintained in a clean condition and should be kept clean.

Storage of fuel and other petroleum products or of different cleaning and sanitizing agents should be so arranged that there is no possibility of contamination of surfaces with which fish come in contact.

Any exposure, even for a short time, of fish to petroleum products, very often results in rejection or eventual destruction of the whole load. The odour and the taste of fish contaminated with fuel or other similar com-



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pounds are very persistent and difficult to remove during the subsequent processing, and such fish should therefore be discarded.

- 4.3.2 **An ample supply of cold potable water or clean sea water under adequate pressure should be available at a sufficient number of points throughout the fishing vessel. On large vessels engaged in fish processing a supply of hot water at a minimum temperature of 82°C (180°F) should also be available**

Only potable water or clean sea water should be used on fish and on surfaces with which fish might come in contact. Even if the fish is caught in polluted waters, as occasionally happens, that water should not be used for washing fish or for the preparation of refrigerated sea water, or refrigerated brine.

Fish when alive is relatively resistant to a polluted environment but loses its natural defences when it dies after being caught.

- 4.3.3 **A system for injecting chlorine into the lines of sea water which is used in the processing of fish or for the clean-up of the vessel should be provided where practicable**

It has been established in the fish processing industry that the injection of chlorine into a supply of cold water, used for general wash-up, helps to control microbial contamination.

The fishing vessels involved in handling or processing large quantities of fish might gain considerably in sanitation by having chlorine introduced into the water lines. Chlorine dosage should be around 10 ppm during the normal use and 100 ppm of residual concentration during the clean-up.

As a word of caution, the use of strongly chlorinated water in confined spaces such as a vessel's hold could prove objectionable to the operator. For that reason, a system for injecting chlorine should be capable of varying the amount of chlorine delivered.

There are a number of relatively inexpensive and easily operable instruments on the market that will perform this task with the minimum of cost and maintenance.

The installation of a chlorine injection system might not be practical for small fishing boats.

- 4.3.4 **Deck hoses should be supplied with clean sea water, at adequate pressure, by a pump used only for clean sea water**

A good supply of clean sea water, at adequate pressure, with an addition of chlorine, if possible, should be available for washing fish and for flushing and rinsing of decks, holds, gear and other equipment which comes in contact with fish.

The intake for sea water should be well forward of and on the opposite side of the vessel from the toilet waste and engine cooling discharge. Sea water should not be used while the vessel is in harbour nor in areas where there is a danger of it being polluted. Clean sea water should be taken in while the vessel is in forward motion.

The piping for the clean sea water supply should have no cross-connections with the engine or condenser cooling system. It should be so constructed as to prevent any possibility of back-siphonage from the kitchen sink or toilets.

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**4.3.5 Ice used in every fishery should be made from potable water or clean sea water and should not be contaminated when manufactured, handled or stored**

Ice made from water which is neither potable nor clean sea water may contaminate the fish with water-borne micro-organisms or other objectionable or even harmful substances. Such contamination will result in the loss of quality, reduced keeping time or might create a definite health hazard.

Some of the larger fishing, collecting or fish processing vessels might have their own ice making machines. The water used in the ice manufacture should be potable water or clean sea water. The sea water intake for the pump should be located on the opposite side away from the waste discharge and engine cooling water outlets of the boat. Chlorine injection into the lines or water storage tanks, or the use of UV lights for continual flow purification should be provided. Both systems are easy and inexpensive to operate. The sea water for ice manufacture should only be taken from areas known to be relatively unpolluted and without any visible discoloration or suspension.

The ice making plant should be cleaned regularly and maintained in a clean, hygienic condition at all times.

When vessels are taking ice to sea, only fresh clean ice should be taken on board at the beginning of each voyage. Ice left from the previous voyage should be discarded and removed from the vessel.

**4.3.6 The use of clean sea water ice cannot be given unqualified recommendation**

The use of clean sea water ice may be necessary in some areas, where there is a shortage of potable water, and there may also be some advantage in using clean sea water to manufacture ice at sea. The initial melting temperature of clean sea water ice may be as low as  $-5^{\circ}$  to  $-6^{\circ}\text{C}$  ( $23^{\circ}$  to  $21^{\circ}\text{F}$ ), but due to the leaching away of salt in the melt water, the melting temperature may rise again to nearly  $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ). Temperature, therefore, is variable. There is a risk that some of the fish stored in clean sea water ice will become partly frozen or too salty. Some experimentation prior to deciding on the kind of water for ice production is recommended.

**4.3.7 The vessel's toilet facilities, all plumbing and waste disposal lines should be so constructed as not to contaminate the fish**

All the plumbing and waste disposal lines servicing the vessel's toilets, hand wash basins or kitchen sinks should be large enough to carry peak loads, be watertight and preferably should not go through the fish holds where fish is being handled or stored.

**4.3.8 Where bait is carried, it should be held in such a manner that it will not contaminate the catch**

Fishing vessels which depend on bait for their fishing activities should have a separate pound or special container where the bait could be held well protected and away from the catch. When fishing is finished, the ice used for bait preservation should be discarded rather than re-used on fresh fish intended for human consumption.

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**4.3.9 On large fishing vessels, engaged in fishing as well as fish processing, suitable washing facilities should be provided**

Such facilities should be located in toilets and close to the fish handling or processing areas. They should be supplied with clean water, soap and towels (preferably disposable).

**4.3.10 The fishing vessel should be equipped with brushes, scrapers, water hoses, spray nozzles and other suitable washing and sanitizing equipment**

Although there is a variety of cleaning and sanitizing equipment available on the market, good quality hand brushes of several sizes and shapes are still the most inexpensive and versatile tools for cleaning operations. Brushes should be kept in a clean and sound condition, disinfected after each use (dipping in 50 ppm chlorine solution is recommended) and when not used should be stored in a dry state. Brushes could spread dirt and micro-organisms. Micro-organisms will proliferate in a dirty brush when stored in a wet condition. The use of steel-wool for scouring should be avoided as there is a constant danger of introducing small, sometimes hardly visible, bits of wire into the final product. If for some reason cleaning cannot be done effectively with a good brush, then plastic, brightly, coloured scouring pads might be used.

The high pressure and high frequency oscillating water or detergent spraying equipment has been found to be quite effective in cleaning, but it usually requires an experienced operator to prevent damage to painted surfaces.

**4.3.11 If poisonous and harmful materials, including cleaning compounds, disinfecting materials, and pesticides are stored on board the vessel, they should be kept in a separate compartment, reserved and marked specifically for this purpose**

Extreme caution must be exercised to prevent poisonous or harmful materials from contaminating the fish. All such materials should be prominently and distinctly labelled so that there can be no confusion between these and edible materials used aboard the vessel. Such compartments should be kept locked and the materials contained in it should be handled only by personnel trained in their use.

**4.4 Equipment and Utensils**

**4.4.1 All fish handling, conveying and storage equipment, used on board fishing vessels, should be designed for the rapid and efficient handling of fish, be suitable for easy and thorough cleaning and should be constructed as not to cause contamination of the catch**

Some of the equipment currently used in the fishing industries is quite unsuitable for the purpose in which it is employed. More thought should be given to the design and layout of fixtures and plant used for the handling, conveying and storage of fresh fish. When obtaining equipment, only equipment which can readily be disassembled for thorough cleaning should be considered.

**4.4.2 Fish washing and conveying equipment should be constructed of suitable corrosion-resistant material and should be easy to dismantle for cleaning purposes and be fitted with chutes or similar means of conveying fish**



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**into the hold. Chutes should be of sufficient length and fitted in such a manner that fish do not have to drop more than one metre (three feet) into the hold**

Washers should, when possible, be fitted with chutes or conveyors for efficient handling purposes and to prevent bruising or other damage to the fish, which often occurs when rough manual methods are used. Washers should be designed to give an adequate washing period, and should have a copious and continuous supply of cold clean sea water. The water should enter the washer through a number of jets, placed so that a water swirl is formed in the washer, allowing dirty water and scum to spill off and drain away. Water used in fish washing and cooling should not be recirculated.

**4.4.3 Conveyors used in the fish hold should be made of corrosion-resistant material and should be easy to dismantle and remove for cleaning purposes**

Fish holds are difficult to clean thoroughly and any board structures or any conveying equipment should be capable of easy removal, so that access can be gained to all areas of the fish hold.

**4.4.4 All tubs, tanks, barrels and other containers used for handling and conveying fish should be of corrosion-resistant material and easy to clean**

In many areas wicker baskets are used for handling fish on deck. These are very difficult to clean properly, as slime, blood, scales and small pieces of offal or parts of fish body become lodged within the framework. Containers with smooth, waterproof surfaces which are easy to clean and disinfect are recommended for handling quantities of fish on deck.

**4.4.5 Where sizeable quantities of fish are handled on board large fishing vessels, the use of machinery designed to carry out cutting and cleaning should be considered**

In many fisheries there is a growing need to save manpower but this cannot be accomplished without the introduction of more mechanical aids for working the fishing gear and handling the catch. These two principal tasks have to be performed by the same crew.

Gutting, which is usually the most time consuming operation, could easily be carried out by a gutting machine. Such machines have been developed and have been used by some fishermen in various countries.

It is advisable, before large expenditure of capital is made, that such machinery should be tested, bearing in mind that it will be operating under extremely rigorous conditions with limited possibilities for proper maintenance or immediate repair.

**4.4.6 All containers used for ice stowing of fish should be of uniform and suitable size, easy to handle when loaded, and should be constructed of suitable corrosion-resistant material**

Such containers should be capable of accommodating the larger fish without bending and, when fully loaded, should be easy to handle by one or two men without tilting, tipping or jerking.

If wooden boxes are used, they should be of a smooth construction and of durable, non-toxic and waterproof finish.

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Baskets should not be used for handling fish on board the vessel or on shore, as they are difficult to clean and disinfect.

**4.4.7 Shovels and rakes used in the handling of fish should also be made of a suitable corrosion-resistant material and should be kept clean**

These implements are used frequently in many stages of fish handling and therefore should meet the same hygienic specifications as other equipment and utensils.

**4.5 Hygienic Operating Requirements**

**4.5.1 Before any fish comes aboard, and between each haul of the gear, decks, boards, stanchions and all other deck equipment which will come in contact with fish should be hosed down with clean sea water and brushed to remove all visible dirt, slime and blood**

The purpose of this washing is to remove all traces of contaminating matter, such as slime, blood, tar, oil, etc. which may cause discolouration and offensive odours in the fish. In most fisheries this cleaning can be carried out while the net is in the water.

It is also important to have the surface of the deck and deck pounds well precooled by hosing them down with cold clean water before the fish is unloaded. During the warm weather, the surface temperature of the deck could be very high. It would be bad practice, therefore, to dump the catch on such a deck without any concern for the quality of the fish, especially those from the bottom layer which, in all probability, will remain for a longer time in direct contact with the hot surface of the vessel's deck.

**4.5.2 All tubs, tanks, barrels and other equipment used in handling, gutting, washing and conveying operations should be thoroughly cleaned, disinfected and rinsed after each cycle of operations**

Any filth, slime, blood or scales if allowed to dry and accumulate on surfaces with which fish comes in contact will be very difficult to remove later and will thus contaminate the subsequent loads of fish.

**4.5.3 During fishing trips the fish hold bilge sump should be drained regularly. The sump should be accessible at all times**

Bilge water containing blood and slime, if not regularly pumped out, will provide a perfect medium for the multiplication of micro-organisms and give rise to offensive odours in the fish hold.

**4.5.4 Cod ends and other parts of the fishing gear which come in contact with fish should be freed of dead fish and organic material after each haul. All gear should be thoroughly cleaned when fishing has ceased**

Dead fish and organic matter left in the nets will decompose and contaminate later catches.

**4.5.5 Sea water which has been used for cooling engines, condensers or similar equipment should not be used for washing fish, deck, hold or any equipment which might come in contact with fish**

The water used for cooling engines is usually at a higher temperature than fresh sea water and might be contaminated with oil or other petroleum products or contain rust and other by-products of metal corrosion.

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Such water, therefore, will accelerate considerably the spoilage of fish by raising their temperature and might impart objectionable taste, odour or undesirable discolouration.

**4.5.6 When cleaning and hosing operations are carried out while the vessel is in port, potable water or clean sea water should be used**

The water should always be free from objectionable contamination. The total number of micro-organisms in it should be low, and it ought not to contain any micro-organisms of public health significance. Contamination of the fish by water-borne micro-organisms and other undesirable substances will result in the loss of quality and might become a health hazard. Harbour water is usually heavily polluted, and should never be used for cleaning purposes. This is also true for water in the close vicinity of towns, villages, industrial plants, fish processing establishments and factory ships.

**4.5.7 Immediately after the catch is unloaded, the deck and all deck equipment should be hosed down, brushed, thoroughly cleaned with a suitable cleaning agent, disinfected and rinsed**

Fish blood, guts, slime and dead fish left on the deck will support multiplication of micro-organisms which may contaminate future catches. If allowed to dry, slime, blood and scales are very difficult to remove.

It is important to realize that thorough cleaning should always precede disinfection especially when chlorine is used as the disinfecting agent. Any organic matter, which if not removed from the surfaces that are to be disinfected, will rapidly combine with and neutralize the micro-organism killing ability of chlorine or any other disinfectant.

**4.5.8 Immediately after the catch is landed the fish hold and bilge sump should also be emptied completely. All surfaces in the hold, pound boards and sump should be thoroughly cleaned with a suitable cleaning agent, disinfected and rinsed**

This is necessary to remove all fish slime, blood and other residue as soon as the catch is landed, in order to avoid multiplication of micro-organisms, offensive odours and the drying of residues on the hold or other surfaces. Cleaning should be completed before the fresh ice is taken on board for the next trip.

**4.5.9 In ships using refrigerated sea water or refrigerated brine systems for the preservation of the catch, all tanks, pumps, heat exchangers and other associated equipment should be cleaned immediately after discharging the catch. Potable water or clean sea water containing a suitable cleaning agent should be circulated through all parts of the system. Tanks should be inspected carefully and cleaned out by brushing if necessary**

Since anaerobic micro-organisms are particularly active under tank storage conditions, a very high standard of sanitation is required to avoid their build up and the spread of infection from one tank to another.

Immediately after unloading, when surfaces are still wet, the holding tanks should be washed with cold potable water or clean sea water under adequate pressure then scrubbed with a brush using an alkaline detergent solution, then followed by a rinse with warm and cold water.



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All pumps, pipes and heat exchangers should be thoroughly flushed with clean cold potable water or clean sea water, then followed by circulating through the system either a hot alkaline solution or cold water to which a strong cleaning agent has been added. After rinsing with potable water or clean sea water, a suitable disinfectant should be circulated through the system. It has been regarded by many fishermen as good practice to leave a weak solution of a non-corrosive disinfectant in the system. This of course must be drained and rinsed out thoroughly with potable water or clean sea water before filling the tanks.

**4.5.10 Where refrigerated sea water is used for the preservation of fish, only clean sea water should be used and should be changed as often as possible to prevent the accumulation of contaminating materials**

Use of sea water contaminated with sewage or industrial discharges will affect the quality of the catch or render it unfit for human consumption. It is advisable for fishermen to check with the local authorities which areas are likely to be free of pollution. The intake for the vessel's sea water pump should be located on the opposite side away from sewage, waste discharge and engine cooling water outlets of the boat. Clean sea water should be taken in while the vessel is in forward motion.

**4.5.11 Where cutting benches are installed these should be provided with channels or chutes which have a continuous supply of clean sea water to carry the guts over the shipside or to a suitable collecting container**

Where fish are contaminated by offal and filth from the gutting operations, the spoilage rate will be increased and all surfaces with which the guts come into contact will also become contaminated. The installation of gutting benches makes the task easier, but care should be taken to ensure that the benches are kept in a hygienic condition.

In disposing of offal into the surrounding water, some consideration should be given to the possibility of a serious pollution problem, especially if this is done in sheltered waters, close to public beaches or inhabited areas.

**4.5.12 Adequate precautions should be taken to ensure that human and other wastes from the fishing vessel are disposed of in such a manner as not to constitute a public health and hygienic hazard**

With man's increased concern for the protection of his environment, in some countries the disposal of any waste from any boat into the surrounding water is restricted by law.

The fishermen should be fully aware of their responsibilities in this regard. Discharge of animal, human or any other wastes from the fishing vessel into the sheltered waters close to man inhabited areas, or over the shellfish growing areas should not be practised.

**4.5.13 Effective measures should be taken to protect the fishing vessel against insects, rodents, birds or other vermin**

Rodents, birds and insects are potential carriers of many diseases which could be transmitted to man by contamination of fish. Fishing vessels should be regularly examined for evidence of infestation and, when required, effective control measures should be taken.

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All rodenticides, fumigants, insecticides and other harmful substances should be used only in accordance with the recommendations of the appropriate official agency having jurisdiction.

**4.5.14 Dogs, cats and other animals should be excluded from areas of the vessel where fish is received, handled, processed and stored**

Because of public health hazards and for aesthetic reasons, no surface of the fishing vessel and of the equipment thereon which comes in contact with fish should be exposed to contamination with animal hair or excreta.

**4.5.15 When a vessel converts to storing fish in ice for human consumption, after catching species such as herring for reduction purposes, the hold and bilge must be thoroughly cleaned, disinfected and rinsed**

Cleaning should be carried out with high pressure potable water or clean sea water containing a suitable cleaning agent, followed by a thorough rinsing. A suitable disinfectant should then be applied to all surfaces and remain in contact long enough to complete the disinfection. Always, when using commercial products, the manufacturer's recommendations as to the concentration and treatment time should be followed. Finally the hold should be thoroughly rinsed with potable water or clean sea water.

**4.5.16 Food supplies for the ship's kitchen or for the crew's mess should never be stored in ice bins where fish are kept**

Storage of such materials in ice intended for fish might contaminate the ice and the fish.

**4.6 Handling the Catch on Board**

**4.6.1 Duration of the fishing trip for a fishing vessel should be determined by the facilities available on the vessel for handling and keeping the catch well chilled, distance from the processing plant and the local environmental conditions**

From the time the fish are caught there is a continual and irreversible deterioration in quality. The progress and degree of such deterioration are governed mainly by the time the fish are held and the temperature at which they are handled and stored on board a fishing vessel. With short distances from the processing plant or market more time could be spent on the fishing grounds providing the boat is equipped with adequate facilities to handle, effectively chill and hold the catch at a low temperature.

**4.6.2 Handling the catch should begin as soon as it comes on board. Any fish unsuitable for human consumption should be removed from the catch and kept separate**

Sorting the catch should be done as soon as the fish are taken on board, to remove as quickly as possible fish unsuitable for human consumption. Mixed species catches should also be sorted rapidly not only for the reason stated above but also to avoid possible damage due to abrasion, particularly where the catch contains spiny and rough skin species and to prevent transferring undesirable odours and tastes which may affect the organoleptic quality of the differing species.

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- 4.6.3 **Where it is required to keep species unsuitable for human food, these should always be sorted from the edible catch and kept separate at all times**
- If fish, unsuitable for human food, are brought back to port as, for example, for fish meal manufacture, care should be taken to avoid contamination of the edible catch.
- 4.6.4 **Fish should not be trampled or stood upon, and should not be piled deeply on deck**
- Any physical damage, whether by crushing, bruising, rubbing or scraping assists spoilage and reduces the value of the fish for subsequent food processing purposes.
- 4.6.5 **All fish on deck should be protected from sun, frost, and the drying effects of wind**
- It is essential to prevent the fish temperatures from rising. Each degree of rise in temperature increases the rate of spoilage. If the catch is to be on deck for any length of time, it should be protected by an awning, ice, or even a wet, clean canvas. Drying will lower market value by spoiling the appearance and possibly inducing rancidity. Slow freezing of the catch on deck, in areas where very low temperatures are encountered, should also be avoided.
- If the vessel is undecked, then a clean container, preferably insulated and lidded, should be provided for the protection of the catch.
- 4.6.6 **Line caught fish should, wherever practicable, be stunned as soon as they are taken on board the vessel**
- If fish are allowed to struggle and thrash about on deck, they may not only be badly bruised, but may become exhausted before they die, and their quality impaired. It is of course recognized that the stunning of small fish is impracticable.
- Stunning should be done only on the head and, with some fish, preferably while the fish is still in water. Fish should be landed by hooking under the gills rather than gaffing in the body or lifting by the tail. With heavy fish the spine might break when the fish is lifted by its tail thus resulting in local flesh discolouration and muscle separation.
- 4.6.7 **When fish are to be bled, this should be done immediately after the fish are landed on deck**
- Bleeding is usually quicker and more effective when carried out at a relatively low temperature or when the fish are still alive.
- It is good practice with some fish to bleed them prior to gutting. On the other hand, in some fisheries, the fish are bled by gutting. In the latter case, the fish may bleed better if they are freshly caught. For this purpose the fishermen should take short hauls in order to bring the fish on board alive.
- If bleeding and gutting is done on dead or "spent" fish, the fillets cut from such fish will have a pronounced discolouration rather than the appearance of properly bled fish.



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**4.6.8 Gutting should commence as soon as the catch comes on deck**

The reasons for prompt gutting are, firstly, to sever some of the main blood vessels allowing the fish to bleed and, secondly, to remove the stomach and gut which would otherwise cause a softening of the flesh and accelerate spoilage. Fish in which the guts are full of food will spoil even more rapidly. Although immediate gutting is desirable with most species, the catch in certain fisheries cannot be handled rapidly enough, and advantages gained by gutting may be offset by quality loss resulting from rises in fish temperature. In such circumstances it would be preferable to get the fish under cover and to chill quickly rather than delay the chilling operation by gutting.

**4.6.9 Where rapid gutting is not practicable whole fish should be washed and chilled as soon as it comes on deck**

This helps to remove filth, particularly gut contents squeezed out of the fish to the net, and it helps to prevent excessive contamination during subsequent gutting and handling.

A thorough washing of the fish will reduce considerably the number of spoilage micro-organisms and remove some of the protein digestive enzymes which come from the viscera of the fish.

**4.6.10 It is usually impracticable to gut very small fish. These should therefore be placed in chilled storage quickly**

Any delay in chilling very small whole fish will have an adverse effect on their quality. Failure to stow these fish quickly may expose them to the effect of weather as well as to physical damage.

**4.6.11 Gutting should be complete and carried out with care. Bad gutting might be worse than no gutting at all**

Pieces of gut or liver, if not completely removed, will act as centres from which spoilage will develop. Enzymes from pieces of gut and liver will digest the flesh and facilitate the entry of micro-organisms. Careless gutting, for example, cutting beyond the vent of a fish will also allow the entry of micro-organisms into the flesh. Nevertheless, cuts should be adequate to allow easy access to the belly cavity and complete removal of guts.

**4.6.12 Fish guts should not be allowed to contaminate other fish on deck**

Fish guts contain digestive enzymes and spoilage micro-organisms. If allowed to foul the rest of the catch, the spoilage rate will be increased. This contamination can be prevented by dropping guts into suitable watertight containers or chutes discharging over the ship side.

In disposing of offal into the surrounding water, some consideration should be given to the possibility of a serious pollution problem, especially if this is done in sheltered waters, close to public beaches or inhabited areas.

With bigger boats, handling larger quantities of fish the resulting offal could easily be processed into fish meal. Such machines have been developed for installation on board fishing vessels and are commercially available.

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**4.6.13 Separate and adequate storage facilities should be provided for the fish roe, milt and livers if these are saved for later utilization**

In some fisheries certain by-products of gutting operations are saved either for human food, like fish roe and milt, or for utilization in pharmaceutical industry, like fish liver used in vitamin extraction.

All these by-products should be stored separately from the fresh fish intended for human consumption and should be kept well chilled and protected from sun, rain, wind and frost. Partial freezing of roe might damage it.

**4.6.14 Immediately after gutting, fish should be washed with clean sea water or potable water**

Fish should be thoroughly washed with clean sea water or potable water before being placed under refrigeration to remove all blood, slime and pieces of gut. Fish blood coagulates rapidly and washing will facilitate more complete bleeding, which in turn will improve the appearance of the product. If tanks are used for washing gutted fish, a continual flow of potable water or clean sea water should be provided to prevent the accumulation of contaminating materials. The practice, common in some inshore fisheries, to gut and wash the fish close to land involves the risk of using polluted sea water, and should therefore be discouraged.

Harbour water, which is always polluted in some way, should never be used for washing fish.

**4.6.15 On completion of washing the fish, further handling should be carried out without delay**

Any further postponement in handling the washed fish before it is chilled, reduces its potential keeping time.

Therefore, with the least possible delay the fish should be thoroughly iced or immersed in ice water to bring its temperature down to 0°C (32°F) as quickly as possible.

At higher temperatures a delay of one hour can have a serious effect on the quality of the final product.

Chilling of fish in bulk by cold air or by top icing only should be avoided. It should be mentioned that the rapid chilling of the freshly caught fish will also slow down the onset, duration and relaxation stages of the rigor mortis phenomenon. Although this problem concerns mostly the quality of frozen fish, it could also affect the quality of freshly caught fish when they are left unprotected on the deck exposed to a high temperature. At such a temperature the stiffening of the muscles is accelerated, thus creating strong internal stresses which might result in a break-down of the muscular tissue. In some species of fish the severity and rapidity of this reaction will have a detrimental effect on the quality. Also to many buyers the sign of rigor is equated with freshness. When the rigor is over the muscles become flabby and the fish "pits" easily on application of a slight pressure.

**4.6.16 Deck hatches should not be left open longer than necessary to load the fish**

Only one fishroom hatch should be opened to allow the loading of fish and to prevent undesirable heat leak into the hold. Where two or more

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hatches are open at the same time, a current of warm air may flow through the fishroom, causing undue ice meltage.

**4.6.17 Fish should be allowed to slide down chutes into the hold or be lowered in suitable containers**

Fish can be damaged and their market value reduced if they are thrown or dropped into the hold.

Heavy fish should never be lifted by their tails or dropped on their tails into the hold.

Indiscriminate use of e.g. hay-forks, shovels, rakes and gaffs for handling of fish should be discouraged. Physical damage caused by these sharp instruments will result in shortening of the shelf life of fish, deterioration in quality and diminishing recovery as the fish go through the processing.

Fish are extremely perishable food and should be handled with utmost care at all times.

**4.6.18 Fish should be chilled rapidly in melting ice and should be stored so that the temperature does not rise. For short term storage, however, refrigerated sea water or refrigerated brine may be used**

It is well known that temperature is the most important single factor influencing the keeping quality of fish. It has been shown that cod spoils about five and a half times as fast at 10°C (50°F), and about two and a half times as fast at 4.4°C (40°F), as it does at 0°C (32°F). Expressing this in another way, cod that would remain edible for about 14 days stored at 0°C (32°F) would be edible for only six days if stored at 4.4°C (40°F) and for less than three days if stored at 10°C (50°F). It is also known that the effects of increasing temperature are cumulative; that is, some potential keeping time is lost each time the temperature of the fish is allowed to rise. The extent of this loss depends both on the degree of temperature rise and the length of time the fish remains at the higher temperature. It is, therefore, most important to chill quickly the fish to the temperature of melting ice, soon after capture, and maintain it in a chilled condition until it reaches the consumer. In some areas refrigerated sea water or refrigerated brine is used for chilling and storing the fish. Here again the chilling should be rapid and the system should be capable of maintaining the fish at -1°C (30°F).

**4.6.19 Fish in ice should be stowed in shallow layers**

The best bulk stowage is the shallowest, with the fish well mixed with finely divided ice. It is appreciated that in some fisheries a compromise is necessary, because it is rarely possible to stow all the catch in very shallow layers, a few fish deep, between shelves. It is perhaps not sufficiently recognized that fish at the bottom of a deep pile can lose considerable weight. It has been observed, for instance, the haddock at the bottom of a pound one metre (three feet) deep can lose as much as 15 per cent of its initial gutted weight after about two weeks' storage.

**4.6.20 The practice of shelf stowage is not to be recommended, unless the single layers of fish are completely covered with layers of ice**

In practice, shelf stowage involves the laying out of single layers of fish side by side and head to tail, belly down on a bed of ice, but with no ice among or on top of the fish. Single fish laid out in this manner are only



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cooled from one side, and therefore cool down less rapidly than fish well mixed with ice. The backs and heads of the fish can remain quite warm throughout the storage period, and micro-organisms originating in the gills can spread rapidly along the backbone. It has been found that these shelf stowed fish are inferior in quality compared with fish which have been shallow bulk stowed at the same time.

Where fish are shelf stowed, ice should always be added, around and on top of each layer.

#### **4.6.21 Fish should be surrounded by adequate quantities of ice**

Sufficient quantities of ice are necessary, not only to cool the fish, but to maintain it in a cool condition. There should be enough ice to cope with any heat leaking into the fish room and the ice should be properly distributed. If, at the end of a voyage, fish are no longer completely surrounded by ice, then insufficient quantities of ice have been used. It is difficult to lay down precise quantities required, but icing should be heaviest against shipsides and bulkheads. The heat leak into the hold will depend on its construction, the temperature of the surrounding sea and areas of the vessel adjacent to the fish hold. In warm waters it will be necessary to use greater proportions of ice than in colder climates, and the quantity will also depend on whether the hold is insulated. It must be emphasized that the correct quantities of ice require to be worked out for individual vessels by trial and error. In the final analysis the best way to determine correct ice quantities is to measure the temperature of the fish from time to time. In many countries fishery research organizations are available to give advice on how to measure these temperatures.

Stowage of fish in ice is generally practiced on fishing vessels making trips of a few days or more, but many small inshore vessels do not use ice or any other form of preservation, and consequently there is often considerable and unnecessary loss of fish quality.

#### **4.6.22 Ice should also be used to prevent contact with all surfaces in the fish hold**

It is good practice to prevent fish from coming in contact with ship-sides, bulkheads and all fishroom structures. If fish are pressed against those surfaces, or even against one another, so that air is excluded, a peculiarly offensive type of microbial spoilage takes place, and fish which otherwise appear to be in good condition are rendered quite inedible, because of the development of foul odours and flavours. Inadequate icing may result in fish coming in contact with these surfaces.

#### **4.6.23 Finely divided ice should always be used to give close contact with the fish**

To maintain close contact with the fish at all times, ice used for chilling and preservation should always be finely divided in one form or another. Any large lumps of ice can cause damage to fish. Various forms of ice are used in many fisheries; the important factors are that they should be made from potable water or clean sea water and should consist of finely divided particles to increase their cooling effectiveness.

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**4.6.24 Where boxed stowage is used, the fish should be properly iced and the boxes not overfilled**

The packing of fish with ice, into containers at sea, in some areas, offers a number of advantages for certain fisheries. When properly iced the fish can remain undisturbed in the containers until they reach the processor. Unloading the catch can become a simple operation, and more ice can be added to the containers on landing, without disturbing the fish.

Generally, properly boxed iced fish should be of a higher quality than fish caught the same day and stored in other ways. Each day's catch can also be separated more easily. Since boxes are stacked one on top of another in the fish hold, overfilling with ice or fish will result in crushing and damage to the fish. For efficient cooling, each box should contain a layer of ice on the bottom, then some fish and ice mixed together, and lastly a top layer of ice. Boxing should not be mixed with other methods of stowage during the same trip.

**4.6.25 Fish should not be packed in refrigerated sea water or refrigerated brine to a density of more than 800 kg per cubic metre (50 lb per cubic foot)**

If too much fish is loaded into the tanks, there will not be sufficient space for the free circulation of refrigerated sea water or brine throughout the load, and therefore some fish will not be cooled efficiently. This practice of overloading the tanks will also add an extra load on the refrigeration equipment in which case it will take a longer time to attain the desired temperature conditions or, in extreme cases, these might never be reached. The density of the fish given above is an upper limit and may be high for certain species.

**4.6.26 Where sea water or brine stowage tanks are cooled by the addition of ice, salt concentration should be maintained at about three per cent**

In practice this can be achieved by the addition of salt, the quantity being regulated by the amount of ice used. If the sea water or brine is too diluted, the fish can absorb water and hence quality can suffer.

**4.6.27 A stowage plan should be kept on any vessel fishing for more than a day or two**

A well prepared stowage plan enables the various day's catches to be kept separate when unloading. Fish from different day's catches should never be stored mixed together.

**4.7 Unloading the Catch**

**4.7.1 Unloading the catch should be carried out in a careful manner, and without delay**

In most fisheries the catch is landed after being separated from the ice in the fishroom. Any undue delay at this stage allows the fish temperature to rise, thus increasing the rate of spoilage. For this reason, the landing of boxed iced fish is to be recommended.

There are fish landing installations where the catch could be unloaded from a vessel to a dock-side conveyor within a relatively short time. Such a conveyor will provide for cursory inspection of the catch and will de-ice the fish, spray-wash it and convey the load through the automatic weight recording scale or individual fish counter device.

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Such installations should be constructed of suitable corrosion-resistant material and so designed as not to contaminate or damage the fish or to cause its temperature to rise. A large amount of cold potable water or cold clean sea water would be required for de-icing and washing of fish.

**4.7.2 At the conclusion of each fishing trip, all unused ice should be discarded before cleaning begins**

Ice left in the fishroom, even if it has not been used on the previous trip, may be contaminated with fish spoilage micro-organisms. If this ice is used on any subsequent trips, for cooling fish, it may accelerate spoilage of the catch.

**4.7.3 Mixing of different days' catches during unloading should be avoided**

Batches of fish, of mixed quality, may often fetch a lower price on the market. Poorer quality fish will soon contaminate any of higher quality if they are mixed together. A good quality fish will soon contaminate any of higher quality if they are mixed together. A good stowage plan, showing the position of each day's catch in the hold may avoid mixing.

**4.7.4 Fish should not be damaged during unloading**

As has been mentioned before, the use of hooks, shovels, forks and other such implements for unloading the catch should be avoided, in order that the fish suffer no damage. Where these implements are used they should be handled with great care. Tearing of the flesh reduces the value of the fish and accelerates spoilage.

**4.7.5 Mechanical unloading equipment should be used where possible**

Properly designed systems employing mechanical conveyors, fish pumps or other such equipment can increase the unloading rate and cause less damage than the traditional manual methods. With faster unloading, the time that the fish are exposed to the outside environment may be decreased, thus delaying spoilage. Some effective fish pumps are available for large and small fish and should only be used with potable water or clean sea water. They are not yet suitable for handling all species.

**4.7.6 Bulk or shelf stowed catch should be unloaded into clean containers and immediately placed in a suitable covered area. While lying in this area the catch should be maintained in a chilled condition**

No fish should be allowed to lie on floors or other unclean surfaces and they should not be exposed to direct sunlight. The use of clean containers and a sufficient quantity of ice will increase keeping time.

**4.7.7 Care should be taken that fish are not damaged or contaminated during sorting, weighing and transfer to containers**

Physical damage can increase spoilage rate and badly torn fish are useless for processing purposes.

**4.7.8 When refrigerated brine or sea water boats are unloaded by means of pumps and siphons the compensating or so called "makeup" water should be of the same temperature and hygienic quality as the original brine**

The unloading of the refrigerated sea water boats could be accomplished either by brailing or by the use of fish pumps or syphons.



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If a pump or a syphon is used, a fair amount of refrigerated sea water, as the conveying medium for the fish, will be lost at the outlet end of the system.

To retain the necessary level and volume of water in order to complete the unloading, additional ("makeup") water from an outside source should be added to the system.

Only cold, clean sea water or brine, or potable water should be used to compensate for the loss of the original brine unless a method of recovering the original brine at the fish discharging end of the system and introducing it back into the circulation could be devised.

#### 4.8

#### **Sanitary Control Program**

##### 4.8.1

**It is desirable that each fishing vessel should develop its own sanitary control program by involving the whole crew and by assigning to each member a definite task in cleaning and disinfecting the boat**

A permanent cleaning and disinfection schedule should be drawn up to ensure that all parts of the boat and equipment thereon are cleaned appropriately and regularly.

The fishermen should be well trained in the use of special cleaning tools, methods of dismantling equipment for cleaning and should be knowledgeable in the significance of contamination and the hazards involved.

